Type. Sesia *Apiformis—Ichneumoniformis—Vespiformis.* 19 Species.

46. Amata.—*Mouth* with projecting laminæ, the labia covered by the base of the maxillæ. *Palpi* very short, with only a single joint. *Antennæ* setiform.

Type. Zygæna *Passalis—Cerbera.*

47. Zygæna.—*Palpi* biarticulate; second joint longer, very pilose externally. *Antennæ* incrassate in the middle.

Type. Zyg. *Filipendulæ—Scabiosæ—Quercus.* 17 Species.

48. Glaucopis.—*Palpi* long, recurved, triarticulate; second joint longer, externally pilose; third joint compressed, naked. *Antennæ* setiform, pectinated.

Type. Zyg. *Argynnis—Pugione—Halterata—Infausta.* 65 Species.

49. Procris.—*Palpi* two, slender, recurved, arched, triarticulate; joints nearly equal. *Antennæ* cylindrical.

Type. Zyg. *Statices—Pruni.* 9 Species.

Illiger adds that the following species, which are contained in an appendix, were not referred by Fabricius to any of his new genera:—Papilio *Cenæus—Chremes—Hesperus—Mirus—Pentheus—Darius—Dædalus—Polymenus—Nerina.*

[Communicated by J. G. Children, Esq. F.R.S. &c.]

XVII. *On the Tides in the Port of London. By* John William Lubbock, *Esq. F.R.S. & L.S.*[*]

In the Companion to the British Almanac for 1830, I have published a disquisition on the tides, in which I have endeavoured to show the connection between the theory of the tides and the facts as they are observed in the Thames at London. M. Bouvard compared the observations made at Brest with the results of Laplace's theory; but no other comparison of the kind has ever been instituted; which is highly remarkable in the instance of a phænomenon which is of daily occurrence and striking regularity, and where a vast mechanical power is perpetually exerted before our eyes. The tide-tables which have hitherto been published in this country, have been calculated by methods which are studiously kept secret. The first attempt, however, which has been made to reconcile theory with observation has produced tide-tables which will, I believe, be found as accurate as any of those calculated by empirical rules long tried, and probably often corrected.

[*] Communicated by the Author.

I believe

I believe many persons suppose that no theory of the tides can be expected to apply to places separated from the main ocean by long and narrowing channels, as is the case in the port of London. This notion will, I think, be removed, if it be considered that the condition which justifies the application of the theory to a river, is not that the tides should there be the same in time or in height as they are in the ocean, but that they should be *as regular* in the former as in the latter case; and that we may here reckon upon this degree of regularity *at least.* Such a situation is in fact, what Laplace considers in the case of Brest as a remarkably happy circumstance for the application of theory. "La situation de ce port (Brest) est très favorable à ce genre d'observations: il communique avec la mer par un canal fort vaste, au fond duquel ce port a été construit. Les irregularités du mouvement de la mer parviennent ainsi dans ce port très affaiblies: à peu près comme les oscillations que le mouvement irrégulier d'un vaisseau produit dans le baromètre sont attenués par un étranglement fait au tube de cet instrument."—*Mémoires de l'Institut*, 1818: p. 1.

As long as the bed of the river continues the same, the tide will be regularly transmitted to any point of it, modified only by an alteration of the constant quantities in the formula which the theory gives. This will be the case, even if we suppose the tide which we have here, to be compounded of two tides which arrive by different courses and after different intervals, as might very easily be shown to follow from the nature of the expression by which the height of the water at a given time is represented. The theory of the tides of Laplace in the second volume of the *Mécanique Céleste*, is one of the most splendid instances of his unrivalled skill in the application of mathematics to questions in physical science; and there can be no doubt that his theory will give the circumstances of the tides at the port of London. Laplace no where hints at any restriction which would exclude such a case, and accordingly it is included with others in the *Annuaire du Bureau des Longitudes.* It is however somewhat remarkable that the table which is given in that work has not undergone any alteration since the time of Bernouilli, who first gave it, or has ever, as far as I am aware, been compared with observation.

This being so, it must, I think, be considered a work of some interest to institute upon a sufficient number of observations a comparison of the theory with the facts; and this is what in the course of last year I executed with regard to the times of high water, employing for the purpose no less than nine thousand observations of those made at the London Docks in the course of twenty-five years.

It is found that the times of high-water calculated from the table given in the *Annuaire*, would differ widely from the observed time; but by applying the formula from which this table was deduced with alterations in the constant quantities, according to Laplace's theory, the mean of the observed times agrees with the time calculated, with an exactness which amounts almost to identity, as will be seen by the following table, which results from the expression,

$$\tan 2\,(\theta' - \lambda') = \frac{\frac{m\,\mathrm{P}^3}{m'\,\mathrm{P}'^3}\,\sin 2\,(\theta - \theta' - \lambda + \lambda')}{1 + \frac{m\,\mathrm{P}^3}{m'\,\mathrm{P}'^3}\,\cos 2\,(\theta - \theta' - \lambda + \lambda')}$$

in which equation P is the parallax of the sun.
θ ...... hour-angle of the sun, at the time of high water.
m ...... mass of the sun.

The same quantities dashed refer to the moon.

λ and λ' are constants depending upon the local circumstances of the port, and their values for the London Docks deduced from all the tides observed by day during twenty-five years are, $\lambda' = 1$ hour 32 minutes, $\lambda - \lambda' = 2$ hours.

The logarithm of $\frac{m\,\mathrm{P}^3}{m'\,\mathrm{P}'^3}$ deduced from the same observations is 9·52452.

If, according to M. Damoiseau (*Mémoires des Savans Etrangers: Théorie de la Lune*), vol. i. p. 502, the mass of the moon be equal to the mass of the earth divided by $\frac{1}{75}$, and the moon's mean horizontal equatorial parallax be 3431″·73, page 569; and if, according to Laplace, *Exposition du Système du Monde*, page 12, the sun's mean parallax be 26″·54, or 8″·59; and if, according to the same work, page 209, the mass of the earth be equal to that of the sun divided by 354936 $\log. \frac{m\,\mathrm{P}^3}{m'\,\mathrm{P}'^3} = 9{\cdot}62170$. The value of the same quantity deduced by Laplace from the observations of the tides at Brest, is 9·62833. The column headed "Observed," is the mean of about nine thousand observations; in which, as they were made at all seasons of the year, the variations in the declinations of the sun and moon and the equation of time can have no perceptible influence. The inequality of *variation* in the moon's

parallax

parallax might influence the result; its effect is difficult to determine exactly, but it must be nearly insensible.

Time of the Moon's Southing.	Time that the Moon's Southing precedes the Time of High-Water.			
	Observed.		Calculated.	
0	2h	2m	2h	0m
1	1	47	1	47
2	*1	32	*1	32
3	1	18	1	17
4	1	5	1	4
5	*0	55	*0	55
6	0	52	0	54
7	1	3	1	6
8	1	32	1	32
9	1	59	1	58
10	2	9	2	10
11	2	10	2	9

As this coincidence has been misunderstood, I may remark that the calculated times were made to correspond with the mean of the observed times in *two places only;* namely, in those which correspond to the moon's southing at two and five hours: their near agreement *throughout*, proves that the form of the expression from which the calculated times were deduced, is correct. Their coincidence in the first of these points amounts to inferring from the observations the values of the constants λ and λ'; their coincidence in the second amounts to inferring the value of the fraction $\frac{m\ P^3}{m'\ P^3}$ from the observations, the difference would be altogether inconsiderable if the received values of the quantities m, m', P, and P$'$, had been adopted. This mean result is not affected by the neglect of the equation of time which is perhaps perceptible in the table of page 66, in the Companion to the British Almanac.

The observations seem to indicate a mass of the moon greater than that which has been deduced from the phænomena of precession and nutation; but to determine so delicate a point, the observations must be discussed and examined with greater care, and the effect of the inequality of *variation* in the moon's parallax considered.

I regret that I was misinformed with respect to the manner in which the *time* was obtained. It was not taken from Rotherhithe

therhithe church, as I stated in the Companion to the British Almanac, but frequently from the clock of Wapping church, which is close to the pier-head; but this point is of no consequence whatever.

It may perhaps interest some of your readers whose notice has been drawn to this subject, to see a comparison between the calculation and the fact, as far as the time has yet gone. M. Dessiou's calculations begin with the 1st of January: thirteen days of that month only have now elapsed; and the shortness of the time is of itself a serious obstacle to any exact agreement of theory and observation; for such an agreement is to be looked for only in mean results deduced from many comparisons. The accidental causes which influence particular tides are so many and so obscure, and the mode of observation so inexact, that I do not conceive that either these tide-tables, or any other, can be free from deviations from the noted time, which may often amount to a quarter of an hour. It appears by the following register and calculations, that, as far as the observations have yet been made, the mean time of high-water at the London Docks has differed by less than four minutes from the tables in the British Almanac.

I am well aware that the practical application of this subject requires considerable caution, and that the observations which it would be desirable to make, are by no means so simple as might at first be imagined. The difficulty arising from the insensible change of the height of the tide just at the maximum, which produces what is called the hanging of the tide, is of an obvious nature. It may not perhaps be so obvious that the rise and fall before and after the maximum are by no means symmetrical; but this I understand from Captain Eastfield is the case, under whose superintendence a most valuable series of observations has been undertaken at the East India Docks, but which are not likely to be continued for any great length of time. In a country like ours, where both from scientific and commercial considerations the subject of the tides is so well worth attention, it is not too much to hope for the assistance of Government in procuring at least one series of accurate observations continued for many years.

When the mode of observing the time of high-water has been rendered as accurate as it ought to be and might easily be made, and when a series of observations have been made on such an improved plan, we may endeavour to introduce greater exactness into our tables; but at present the agreement is more than sufficient for practical purposes, and the mean error is within the limits of the errors of the observations.

Comparison of Tides observed January 1 *to* 13, 1830, *with the Tide Tables in the British Almanac.*

1830.	A.M.			P.M.		
	Observed.		Calcul.	Observed.		Calcul.
	London Docks.	St. Katherine Docks.	British Almanac.	London Docks.	St. Katherine Docks.	British Almanac.
Jan. 1	6^h 15^m	6^h 8^m	6^h 1^m	6^h 45^m	6^h 32^m	6^h 26^m
2	7 10	7 8	6 52	7 30	7 47	7 22
3	7 50	8 10	7 54	8 40	8 50	8 30
4	9 0	9 8	9 8	10 0	10 5	9 49
5	10 20	10 30	10 29	11 5	11 5	11 6
6	11 35	11 40	11 41	0 0	0 0	0 0
7	0 15	0 15	0 11	0 30	0 25	0 39
8	1 10	1 8	1 6	1 20	1 20	1 29
9	2 0	1 53	1 51	2 5	2 15	2 11
10	2 35	2 39	2 31	2 45	2 38	2 49
11	3 15	3 16	3 7	3 35	3 40	3 25
12	3 45	3 48	3 41	4 0	4 13	3 58
13	4 20	4 25	4 14	4 45	4 50	4 29
	69 30	70 8	68 46	63 0	63 40	62 13
		Equation of time	1 24		Equation of time.	1 24
			70 10			63 37

The tide-tables in the British Almanac are calculated to apparent time, as are all the tables in the same publication, as the observations are in the mean time, the mean error

$$\text{A.M.} = \frac{70{\cdot}10 - 69{\cdot}30}{13} = 4 \text{ minutes nearly}$$

$$\text{P.M.} = \frac{63{\cdot}37 - 63{\cdot}0}{13} = 3 \text{ minutes nearly.}$$

XVIII. *On a new Salt obtained by the partial Decomposition of Perchloride of Mercury.* By R. Phillips, *F.R.S. L. & E., &c.*

THE action of chlorides and water, as a theoretical subject, has perhaps occupied more than a requisite degree of attention: it has however again lately excited my notice, and the experiments suggested by it have led to the formation of a mercurial salt which has not, I believe, hitherto been described.

Although when some chlorides,—those, for example, of antimony and bismuth,—are mixed with water, we have demonstration of the production of muriatic acid and a metallic oxide by their mutual decomposition; yet the supposition of similar action is sometimes attended with considerable difficulty, and especially when the base of the chloride has but slight affinity for oxygen, as in the instances of gold and mercury.